or ingenious execution. But at the same time, and on the other hand, there is no small danger that we may fail to give proper recognition to those other astronomers whose lives, unmarked by brilliant achievements, have been devoted to labours which are none the less valuable because they have been accomplished while quietly pursuing recognised lines, and are therefore devoid of conspicuous originality. In particular, the work of computation and arithmetical reduction of observations, without which the observations themselves either cannot be made or must remain almost entirely useless, is apt to fall into disrepute, as being wholly mechanical and unenterprising. This is certainly to be regretted; for just as a victorious general marching forward in the enemy's country must depend for his very safety on the fidelity and capacity of those officers who hold the conquered territory, so our scientific knowledge is liable to become disconnected and fragmentary unless we have capable men ready to perform the task of computing from the observations, and co-ordinating the results achieved in more exciting spheres of scientific work. If the pursuit of such unostentatious work lead to the effacement of the worker, our gratitude should be even all the greater for the self-denial exhibited and practised. Of such a man we have recently had to lament the loss, owing to the sad death of Dr. Tietjen, of Berlin.

Friedrich Tietjen was born in Oldenburg, in the year 1834; we therefore lose his services at the comparatively early age of sixty-one. He studied mathematics and astronomy at Göttingen, and subsequently at Berlin, with which latter city he has been continuously connected. In 1861, he became attached to the staff of the Berlin Observatory, and in one or other capacity this connection remained unbroken till the time of his death. He was appointed Professor of Astronomy in the University of Berlin, and Director of the *Recheninstitut*, allied to the Berlin Observatory. In his earlier career, Dr. Tietjen occupied himself with the observations of comets and asteroids, discovering in this way the asteroid *Semele.* To his activity and devotion the pages of the *Astronomische Nachrichten* abundantly testify. He is also known as the calculator of several cometary orbits, and also of the orbits and ephemerides of many asteroids. Some twelve years later, Dr. Tietjen became superintendent of the *Berliner Astronomisches Jahrbuch*, and his reputation in that capacity is not less assured than that of Dr. Powalky, who had preceded him in that office. As official director he paid great attention to shortening the labour of the necessary calculations as far as possible. Some of his methods have been published, others are not so well known, ill-health having prevented him from giving them to the world. Of the value and of the accuracy of this publication under the superintendence of Dr. Tietjen it is unnecessary to speak here, for it is sufficiently well known. Probably his most useful work was that done in superintending the preparation of the ephemerides of the small planets, the continual and rapid increase in the number of which, while it enormously increased his work, had likewise the effect of lessening the interest in this class of discoveries. While the national almanacks of other countries practically discontinued the publication of this class of ephemerides, Dr. Tietjen loyally struggled to supply sufficient information to ensure the observation of the small planets. Those who have attempted the determination of the mass of Jupiter from the perturbations of these bodies, and similar kinds of work, know how to appreciate the labours of Dr. Tietjen, by which the continuous observation from opposition to opposition has been rendered possible.

This skilled mathematician and remarkably facile computer died at Berlin, on June 21, deeply lamented by his numerous friends, and regretted by many who have profited by the devotion of his quiet unambitious life to the service of astronomy.

THE MAXIM FLYING MACHINE.

On Friday, July 5, a large party of scientific men paid a visit, by invitation of Mr. Hiram Maxim and Mr. Brodrick Cloete, to Baldwyns Park, Bexley, to witness a trial of the celebrated flying machine, and the latest development in the direction of mechanical flight.

The invitations were carefully distributed among those who were competent to judge of the magnitude of the task to be attempted, and who were prepared to examine closely the ingenious mechanical details by which it was clearly demonstrated that the machine had ample power to lift itself off the ground, carrying with it a supply of fuel and water, and a crew for the navigation.

An unscientific crowd of spectators might have become unmanageable, and might have developed iconoclastic tendencies (like the Weser boatmen with Denis Papin's original steam vessel) when the machine did not take to flight immediately and disappear from their astonished gaze.

> "As lewed people demeth comunly
> Of thinges that ben maad more subtilly
> Than they can in her lewednes comprehende
> They demen gladly to the badder ende——"

But the Bexley machine is purposely designed of extreme size, with the intention of thoroughly testing and elaborating the details of the mechanism, and of measuring the lifting power, within immediate reach of a workshop and skilled mechanics, more than of actually taking to the air; this will probably be first attempted with a much smaller machine, capable of lifting one man of jockey-like proportions, and mounted on a boat on a lake, so that short flights, like those of a flying fish, can be attempted for initial practice.

The lifting force of the machine is measured automatically as it runs along a railway track about half a mile in length, as shown in the accompanying illustration (Fig. 1), and the machine is prevented from taking to flight by wheels running underneath the outer wooden rails, seen in the figure; for much yet remains to be done in the way of practice in vertical steering before taking leave of the earth; the chief difficulties of the Aviator beginning when he wishes to descend and alight on the ground again.

Chaucer did not realise the difficulties of the problem when describing so jauntily the Bronze Horse in the Squieres Tale:—

> "This same stede shall bere yow ever-more
> With-outen harm, til ye be ther yow leste,
> Though that ye slepen on his bak or reste;
> And turne ayeyn, with wrything of a pin."
>
> "But whan yow list to ryden any-where,
> Ye moten trille a pin, stant in his ere—"
> "Bid him descend, and trille another pin,"
> "Trille this pin, and he wol vanishe anon."

The "wrything of a pin" is not inapt in describing the dominating gyrostatic brain of the Aviator, designed by Mr. Maxim to perform the vertical steering automatically.

The Bexley machine, complete with the water, naphtha fuel, and crew of three men on board, weighs 8000 lb.; and running at forty miles an hour with a pressure of 275 lb. per square inch, the engines develop 360-horse power, the thrust of the screws is 2000 lb., and the lifting effect of the aeroplanes and wings, 4000 square feet in area, is 10,000 lb.

A thrust of 2000 pounds at 45 miles an hour gives 240 thrust horse-power; or, with a speed of advance of the screw of 60 miles an hour, 320 indicated horse-power.

The total projected disc area of the screws is 500 square feet, each screw being nearly 18 feet in diameter, with a pitch of 16 feet; and thus requiring 330 revolutions a minute to give a speed of advance of 60 miles an hour.

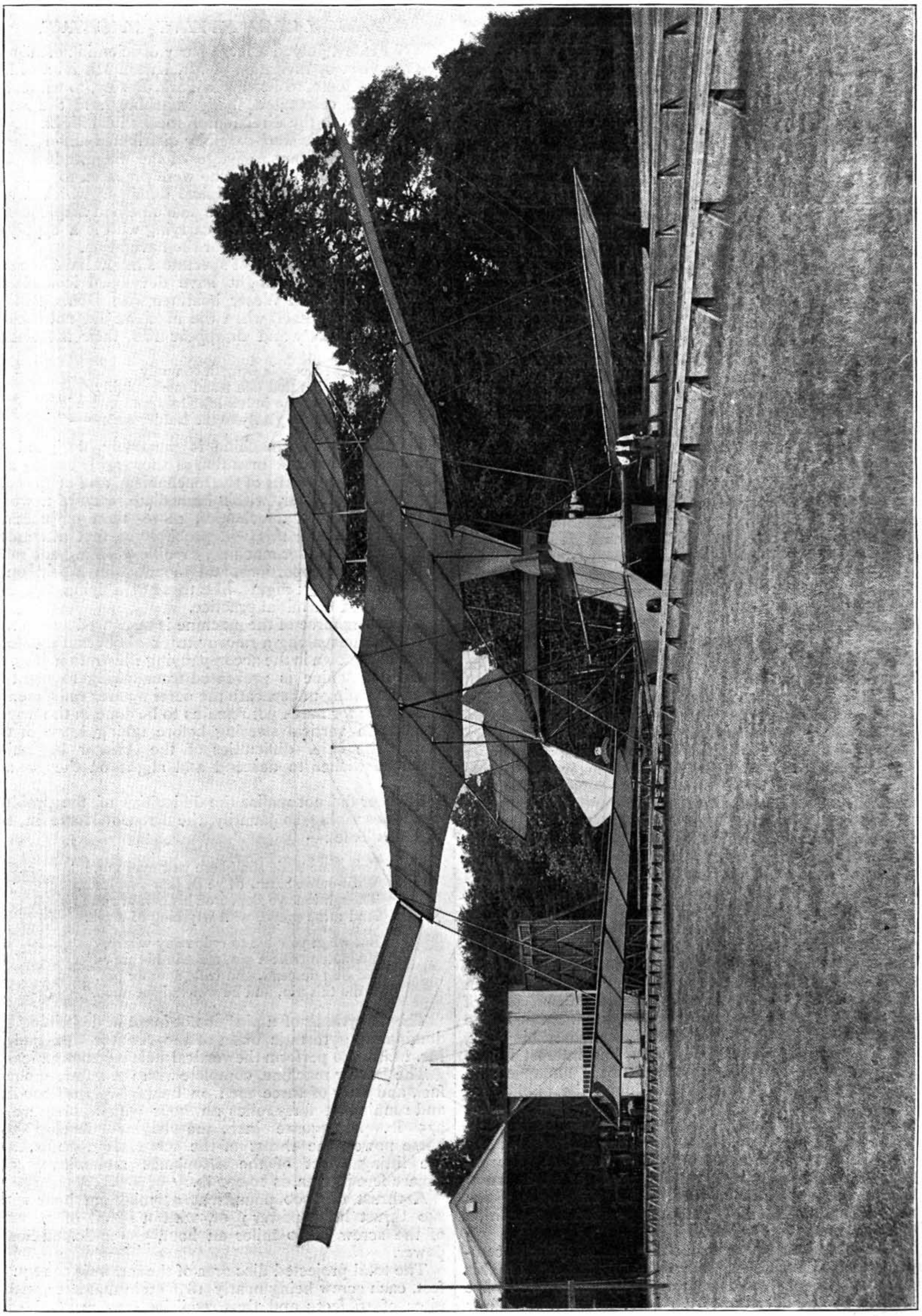

FIG. 1.—General view.

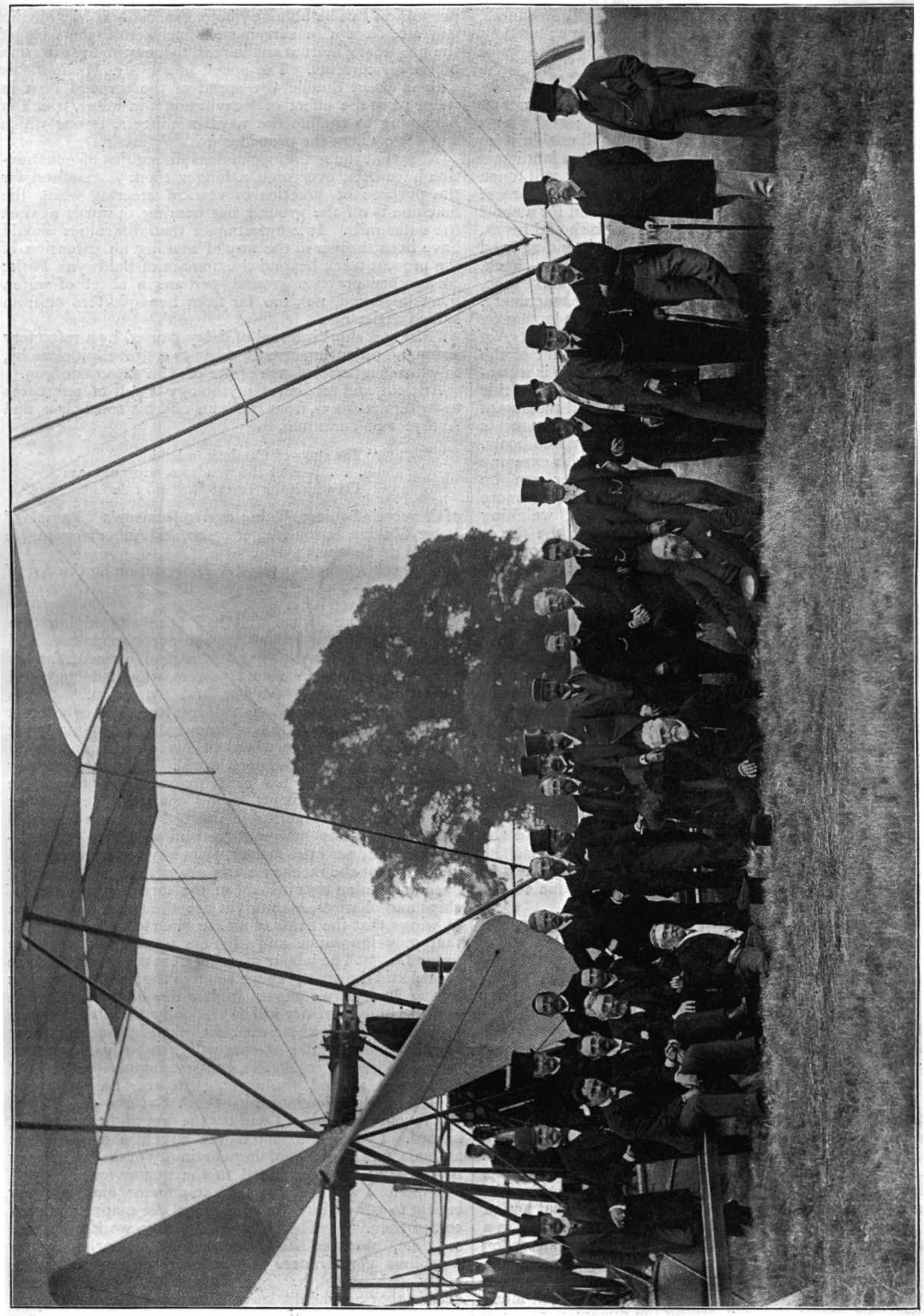

FIG. 2.—One of the screws, showing the connection with the engines.

Mr. Maxim calculates that, after making all allowances, he can at present lift 28 pounds per horse-power; but that, with improvements, he hopes to raise this figure to 50 or 60 pounds, and then a machine could take a flight of 500 or 600 miles.

When the machine is perfected, Mr. Maxim claims that the railway track may be dispensed with; and that a short run over a moderately level field will enable it to attain the velocity necessary to rise. As far as landing is concerned, he says that the aerial navigator will touch the ground while moving forward, and the machine will be brought to rest by sliding on the ground for a short distance. In this manner very little shock should result, whereas if the machine is stopped in the air and allowed to fall directly to the earth without advancing, the shock, though not strong enough to be dangerous (?) to life or limb, might be sufficient to disarrange or injure the machinery.

These numbers are taken from Mr. Maxim's lecture on "Experiments in Aeronautics," before the Society of Arts, November 28, 1894, where a full account of the mechanical details will be found. Each engine is a two-cylinder compound, with the cranks set at 180°; in this way the inertia stresses are self-contained, and racking of the framework is avoided; a similar arrangement is adopted by Mr. Thornycroft in his recent torpedo boats. A photograph showed Mr. Maxim lifting with ease one of these engines, from which 180-horse power can be developed. The boiler is, if possible, a still more wonderful miracle of lightness for its power, weighing only 1000 lb., and providing 360-horse power; the fire is given by a steel burner with 14,000 jets, made from the naphtha vapour delivered from an automatic gas generator. For details the reader must be referred to Mr. Maxim's lecture; but the chief result arrived at may be summarised as a performance of one-horse power for every 11 lb. of weight in the motor complete.

At this rate a 10-horse-power motor can be produced, which will weigh considerably less than an ordinary man; so that when Mr. Maxim can spare a little leisure from this fascinating problem of flight, he can beat easily the performance of the steam carriages recently competing in France, and carry off, we hope, the prize of £1000 offered in this country by the proprietors of the *Engineer*, and some day we may see his motor utilised for purposes of military traction, and galloping round the smartest battery of artillery on Woolwich Common.

Mr. Maxim eschews the gas bag of balloons and the use of vertical screws for securing levitation, and he relies entirely on the upward thrust on the aeroplane and wings, mounted at a slope of about 1 in 8, due to the currents of air rushing past them.

These surfaces are formed of canvas, stretched on a skeleton framework of hollow steel rods for the struts and thin steel wire for the ties; the large central aeroplane is composed of two parallel canvas surfaces, with a space between, and in this way the shape is preserved better; and the general set of the wings, smooth like cardboard, should excite the envy and stimulate the imitation of our sailmakers for yacht racing. The front and rear wings are shown pivoted about a horizontal axis, so as to act as rudders in a vertical plane.

The machine is started from the position in the photograph, being tied up to the indicator post shown in its rear; the propellers are then set in motion, and soon drive a gale of wind in their wake; when the pull of the rope has reached a definite amount, say 2000 lb., a hook is released, and the machine starts on its journey along the track. Mr. Maxim can now carry out his original notion of experiments with a model machine, tied to a post in a gale of forty miles an hour, to be found every afternoon in the cañons of California, in an artificial gale produced in the wake of his propellers. Dynamometers register simultaneously the thrust of the propellers, so that much interesting information concerning the dynamics of screw propulsion can be obtained here, especially if Mr. Maxim will stretch a wire carrying ribbons across the axes of the propellers, in front and in rear, to measure the direction of the air currents. The speed in air Mr. Maxim deals with is about double the speed of the torpedo boat in water; but the effect of "cavitation" in water, which is beginning to trouble the naval architects, is one which will not concern the propeller working in air.

Now that the main mechanical difficulties of construction have been overcome, a longer track is required for the purpose of practice in vertical steering while the machine is off the ground, but bearing upwards against the outer rails. It is unfortunate that difficulties should have been thrown in the way of making an extension of the present track beyond the domain of Baldwyns Park; so another practice ground, perhaps a sheet of water, must be found, not too far from headquarters or from skilled assistance.

During a short interval of delay, caused by a refractory pump, an adjournment was made to a gravel-pit close by, to witness a performance of the Maxim automatic gun.

Ancient and mediæval mythology is full of references to flying machines, from Dædalus and his son Icarus, and Archytas of Tarentum, to

> "The story of Cambuscan bold
> . . . And of the wondrous horse of brass
> On which the Tartar king did ride"

of Chaucer's Squieres Tale; and to Johnson's "Rasselas," Peter Wilkins, Baron Munchausen, and Auber's opera "le Cheval de Bronze."

"Rasselas," chapter vi., "A Dissertation on the Art of Flying," is so curiously apposite that some extracts may well find a place here.

"Among the artists that had been allured into the Happy Valley, to labour for the accommodation and pleasure of its inhabitants, was a man eminent for his knowledge of the mechanic powers, who had contrived many engines, both for use and recreation." "This artist was sometimes visited by Rasselas, who was pleased with every kind of knowledge, imagining that the time would come when all his acquisitions would be of use to him in the open world. He came one day to amuse himself in his usual manner, and found the master busy in building a sailing chariot. He saw that the design was practicable upon a level surface, and with expressions of great esteem solicited its completion. 'Sir,' said the master, 'you have seen but a small part of what the mechanic arts can perform. I have long been of opinion that instead of the tardy conveyance of ships and chariots, man might use the swifter migration of wings, that the fields of air are open to knowledge, and that only ignorance and idleness need crawl upon the ground." "'The labour of rising from the ground will be great,' said the artist, 'as we see it in the heavier domestic fowls; but as we mount higher the earth's attraction and the body's gravity will be gradually diminished, till we arrive at a region where man shall float in the air without any tendency to fall; no care will then be necessary but to move forward, which the gentlest impulse will effect.' 'Nothing,' replied the artist, 'will ever be attempted if all possible objections must be first overcome. If you will favour my project I will try the first flight at my own hazard. I have considered the structure of all volant animals, and find the folding continuity of the bat's wings most easily accommodated to the human form. Upon this model I will begin my task to-morrow, and in a year expect to tower into the air beyond the malice and pursuit of man.'" "The Prince visited the work from time to time, observed its progress, and remarked many ingenious contrivances to facilitate motion and unite levity with strength. The artist was every day more certain that he should leave vultures and eagles behind him, and the contagion seized upon the Prince. In a year the wings were finished, and on a morning appointed the maker appeared, furnished for flight, on a little promontory; he waved his pinions awhile to gather air, then leaped from his stand, and in an instant dropped into the lake. His wings, which were of no use in the air, sustained him in the water, and the Prince drew him to land half dead with terror and vexation."

These extracts show that Dr. Johnson had realised to some extent the difficulty of the problem to be solved; although Herr von Lilienthal's experiments, recently attempted by Prof. Fitzgerald, have to a certain extent falsified the universal application of his final catastrophe.

But, viewed with the cold calculating eye of mechanical science, the poetical descriptions are seen to be hopelessly absurd and impossible; now that Mr. Maxim has taken up the subject, and proved to demonstration the enormous power required, out of all proportion to the size, if man is ever to emulate the birds.

A. G. GREENHILL.

NOTES.

THE Organising Committee of the third International Zoological Congress, to be held at Leyden, September 16-21, has sent us a copy of the provisional programme. The programme contains some details with reference to the work proposed, not given in our previous notes on the forthcoming Congress. At the first general meeting, a discourse will be delivered by Dr. Weismann; Mr. Haviland Field's scheme for bibliographical reform will be reported upon by M. E. L. Bouvier; and a report on the prize instituted in 1892, at the Moscow meeting, will be made by M. Blanchard. At the second general meeting, Prof. Milne Edwards will give a discourse, and Dr. F. E. Schulze will propose the nomination of a commission of three members to draw up, in three languages, the code of zoological nomenclature. Dr. John Murray will address the third general meeting. With regard to the sections: up to the middle of July, the first section had been promised a communication on Weismanism, by M. A. Giard; on cellular theory, by Mr. A. Sedgwick; on Plankton studies, by Prof. Victor Hensen; and a paper by Dr. S. Apathy. Dr. Bowdler Sharpe will address Section II. upon the classification of birds; and there will be papers on the origin of the lacustrine fauna of European Russia, by Prof. N. Zograf (Moscow); on the fauna of Borneo, by J. Buttikofer; and on *Pithecanthropus erectus*, by Dr. E. Dubois. In the third section, Prof. W. Leche (Stockholm) will read an odontological paper, and there will also be papers by Prof. R. Semon (Jena) and Prof. O. C. Marsh. In the fourth section, papers referring to the classification of living and fossil invertebrates, and bionomy, will be read by Dr. V. Salensky, Dr. C. W. Stiles, M. Blanchard, and Prof. S. J. Hickson. The section of entomology has received papers by M. E. de Selys-Lonchamps, Father E. Wasmann, Dr. A. Fritze, and Prof. G. Canestrini. In Section VI., papers on the comparative anatomy and embryology of invertebrates will be read by A. de Korotnev, M. E. Perrier, Prof. J. W. Spengel, and Prof. Herdman. We understand that up to now the following delegates have been officially announced by the respective foreign Governments:—Belgium, Prof. Ed. van Beneden, Prof. Ch. van Bambeke, Prof. Gilson, and Prof. Lameere; France, Prof. Milne Edwards. MM. R. Blanchard, E. Bouvier, A. Certes, J. de Guerne, H. Filhol, Ch. Schlumberger, and L. Vaillant; Great Britain, Sir W. H. Flower, Prof. Sydney J. Hickson, Dr. J. Anderson, Dr. St. George Mivart, and Dr. P. L. Sclater; Sweden, Prof. F. A. Smith; Switzerland, Prof. Th. Studer, and E. Jung; United States (Department of Agriculture), Dr. C. W. Stiles.

A DESIRE is widely felt among the pupils of Prof. Leuckart that the occasion of the fiftieth year of his doctorate should not pass without some durable mark of recognition from those who have known and valued his inspiring influence. It is proposed that the memorial should take the form of a marble bust, and an appeal for contributions is being circulated as widely as possible. There is naturally some difficulty in obtaining the addresses of all old pupils; and it is hoped that those who receive the appeal will make it generally known. Contributions should be sent to Herr Carl Graubner (C. F. Winter's Verlag, Leipzig, Johannes-gasse 8), who has consented to act as treasurer of the memorial fund.

IT is proposed to honour Sir Joseph Lister by presenting his portrait to the Royal College of Surgeons for England, to be placed by the side of the portraits of John Hunter and other great surgeons of the past. On Tuesday last, in the presence of a large company, Sir Joseph was presented with a testimonial, in the form of a portrait of himself, subscribed for by his past colleagues and pupils, as a mark of esteem and admiration, on his retirement from the chair of clinical surgery at King's College Hospital.

THE sixty-third annual meeting of the British Medical Association was opened on Tuesday, when Dr. E. Long Fox retired from the presidential chair, and Sir J. Russell Reynolds was installed as his successor. Dr. Ward Cousins, in moving the report of the Council, said that when they last met in London, in 1873, they numbered only 1500, whereas now their membership exceeded 16,000. The financial position of the Association is most satisfactory, the assets exceeding the liabilities by more than £60,000. In his opening address, Sir Russell Reynolds dwelt chiefly upon the great advances that have been made, during the past twenty years, in the elucidation of both structure and function—such, for example, as in the researches upon the thyroid, the adrenal bodies, the spleen, and the liver; the advance of bacteriology; the function of the axis-cylinder of nerves; and the development of a new field of therapeutics in the serum-treatment of disease.

THE death is announced of Prof. H. Witmeur, Professor of Mineralogy and Geology in the University of Brussels, and of Prof. Josef Loschmidt, at Vienna.

SIR JOHN TOMES, F.R.S., died at Caterham on Monday, at eighty years of age. He was elected into the Royal Society in 1850, after carrying out valuable work referring to dental physiology and surgery. In 1883, with the late Prof. Huxley, he was elected an honorary fellow of the Royal College of Surgeons; and three years later the honour of knighthood was conferred upon him, in recognition of his services to his profession.

WE have already noted that an international conference for the protection of birds useful in agriculture, by helping to destroy injurious insects, has recently been held in Paris. Most of the countries in Europe were represented at the conference; and it was agreed that various measures should be taken to preserve useful birds, and to protect their nests and eggs from destruction. A list of birds considered useful has now been published by the Commission, and as this includes a number of our caged friends as well as other birds at present ruthlessly sacrificed for ornamental purposes, the trade in birds in various directions will naturally be curtailed. We learn from the *Révue Scientifique* that a period of three years is to be accorded to the different countries of Europe to allow them to arrange their laws in accordance with the principles agreed upon by the International Commission.

THE prospectus is issued of a proposed complete directory of living botanists of all countries, inclusive of the officers of botanic gardens, institutes, and societies, as also of their works and the botanical papers issued by them. Any communication should be made to Herr J. Dörfler, III Barichgasse 36, Vienna, of the botanical section of the Imperial Museum of Natural History.